PATENT ABSTRACTS OF JAPAN

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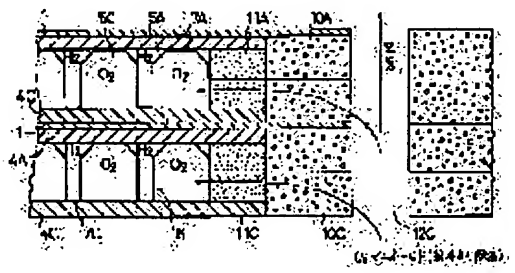
(54) FUEL CELL, ELECTROLYTIC CELL, AND ITS COOLING AND DEHUMIDIFYING METHOD

(57)Abstract:

PURPOSE: To allow efficient cooling and efficient dehumidification by providing a separate plate having anode and cathode reaction gas supplying grooves alternately arranged in parallel to each other, the sectional area of the cathode reaction gas supplying groove being larger than the sectional area of the anode reaction gas supplying groove.

CONSTITUTION: A separate plate having anode and cathode reaction gas supplying grooves 5A, 5C alternately juxtaposed on the same plane is laminated between gas diffused electrodes (anode 4A, cathode 4C) through the metal thin plate of an ion exchange membrane 1 to form a fuel cell and an electrolytic cell. The sectional area of the cathode reaction gas supplying groove is set larger than the sectional area of the anode reaction gas supplying groove. The cathode reaction gas as a cooling gas can be carried in a large quantity, and when air is used as the cooling gas, particularly, cathode characteristic can be also improved together with effective cooling and dehumidifying effect. The supplying quantity of the anode reaction gas can be suppressed at necessary minimum, and the device can be also made compacts.



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CLAIMS

[Claim(s)]
[Claim 1] The fuel cell characterized by for an anode and a cathode reaction gas supply slot standing in a row by turns on the same flat surface through a metallic thin plate or conductive resin sheet metal, and carrying out the laminating of the separator plate with the larger cross section of a cathode reaction gas supply slot than the cross section of an anode reaction gas supply slot to each inter-electrode one.
[Claim 2] A fuel cell according to claim 1 with the volume of a cathode manifold the manifold which supplies the above-mentioned anode and cathode reaction gas is the internal manifold type which has penetrated the electrode surface, and larger [an anode manifold] than the volume.
[Claim 3] The fuel cell according to claim 1 which the manifold which supplies the above-mentioned anode reaction gas is the internal manifold type which has penetrated the electrode surface, and is the external manifold which has the manifold which supplies cathode reaction gas in an electrode side face.
[Claim 4] The cooling / dehumidification approach of a fuel cell of performing cooling of an electrode, and dehumidification of a cathode by passing reactant gas to the fuel cell with which an anode and a cathode reaction gas supply slot stand in a row by turns on the same flat surface through a metallic thin plate or conductive resin sheet metal, and the laminating of the separator plate with the larger cross section of a cathode reaction gas supply slot than the cross section of an anode reaction gas supply slot is carried out to each inter-electrode one.
[Claim 5] The electrolysis cell characterized by for an anode and a cathode reaction gas supply slot standing in a row by turns on the same flat surface through a metallic thin plate or conductive resin sheet metal, and carrying out the laminating of the separator plate with the larger cross section of an anode reaction gas supply slot than the cross section of a cathode reaction gas supply slot to each inter-electrode one.
[Claim 6] An electrolysis cell according to claim 5 with the volume of an anode manifold the manifold which supplies the above-mentioned anode and cathode reaction gas is the internal manifold type which has penetrated the electrode surface, and larger [a cathode manifold] than the volume.
[Claim 7] The electrolysis cell according to claim 5 which the manifold which supplies the above-mentioned cathode reaction gas is the internal manifold type which has penetrated the electrode surface, and is the external manifold which has the manifold which supplies anode reaction gas in an electrode side face.
[Claim 8] The cooling / dehumidification approach of an electrolysis cell of performing cooling of an electrode, and dehumidification of an anode by passing reactant gas to the electrolysis cell which an anode and a cathode reaction gas supply slot arrange in parallel by turns on the same flat surface through a metallic thin plate or conductive resin sheet metal and by which the laminating of the separator plate with the larger cross section of an anode reaction gas supply slot than the cross section of a cathode reaction gas supply slot is carried out to each inter-electrode one.

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DETAILED DESCRIPTION

[Detailed Description of the Invention]
[0001]
[Industrial Application] This invention relates to the cellular structure which can perform efficiently cooling and dehumidification of a low-temperature actuation fuel cell, the fuel cell which especially uses ion exchange membrane, or an electrolysis cell.
[0002]
[Description of the Prior Art] Since a fuel cell is efficient and the pollution-free power plant which use hydrogen and various fossil fuels, it has a great hope socially as a power plant of "postatomic energy" which can cope with energy problems and a full-terrestrial pollution problem. Various fuel cells according to an application, such as an object for a steam-generated alternative generation of electrical energy, an object for the on-site power generation of a building or a works unit, or an object for space, are developed. the greenhouse effect consisting mainly of recent years and carbon dioxide gas, and NOX and SOX etc. -- the acid rain to depend is recognized as serious ****** which threatens the future of the earth. Since one of the main sources of discharge of these public nuisance gas is internal combustion engines, such as an automobile, the tendency which uses a fuel cell as a motor power source which replaces with the internal combustion engine for mount, and operates is increasing quickly. In this case, like much equipment, the thing of a cell small as much as possible is desirable, and it is indispensable that the power density of a cell proper and an output current consistency are high for that purpose. The solid-state polyelectrolyte fuel cell (it is called Following PEFC) using ion exchange membrane (it is called Following PEM) as a candidate of a leading fuel cell who fulfills this condition attracts attention.
[0003] The basic structure of the body of PEFC, an operation, and a trouble are explained here. As shown in drawing 8 , the base of a cell is constituted by joining the anode and cathode which are shown by 4A and 4C by the hotpress to the both sides of PEM1. This anode and cathode consist of conductive porous support, such as carbon paper indicated to be the porosity catalyst bed shown by 2A or 2C by 3A or 3C. Electrode reaction occurs on the catalyst front face of 2A and 2C sections. Anode reaction gas (H2) It is supplied through reactant gas feed-holes 5A to 3A, and is cathode reaction gas. (O2) It is supplied through reactant gas feed-holes 5C to 3C.
the inside of 2A -- :anode reaction H2 -> 2H++ the inside of 2e2C -- : -- cathode reaction 1/2O2+2H++2e -> The reaction of H2 O occurs and the reaction of H2+1 / 202 ->H2 O+Q (heat of reaction) occurs as these reactions being total by the whole cell. Electric work is made, in case electromotive force is acquired and an electron flows the external load 8 with this electrical energy in this process. Since this electromotive reaction is not reversible, irreversible [that / the amount of (overvoltage and call eta shows this)] exists. Moreover, internal resistance (R) exists in a cell, and if a current (I) is passed, the electrical-potential-difference loss of IR will arise. Consequently, only the part of ((etaI+I2 R)+ heat of reaction) does not become power, but is accumulated into a cell as useless heat. Therefore, in PEFC asked especially for high current density operation, cooling of a cell serves as the first important question.
[0004] Furthermore, 2H+ produced in the anode at the electromotive reaction again Although the inside of PEM is moved to a cathode and it participates in the above-mentioned cathode reaction, it is one H+ in this case. An average of 2-2.5 H2 O molecules are accompanied as a hydration molecule. For this reason, H2 If one molecule participates in an anode reaction, 4-5 water molecules will move to a cathode from an anode. PEM will not be sufficient H+ without when moisture recognizes initial-complement existence into the film. There is a property

in which conductivity appears. Therefore, H+ As for the moisture which ran short in the film, it is necessary continuously by carrying out company migration to supply from the outside (at least anode side), and to compensate. If the part which moves the inside of the film to a cathode, and the total body water to be generated in a cathode reaction become abundant and this condenses it in the pore of 2C and 3C, it will check remarkably supply to the catalyst front face in 2C of reactant gas (O2), and will cause the fall of a cell property. Therefore, it becomes the second important question peculiar to PEFC to remove moisture out of a cell, without making condensation cause.

[0005] Generally, a gas separator plate (shown by Notations 6A and 6C in drawing 8 and drawing 9) needs to carry out separation supply of fuel gas and the oxidant gas uniformly at an electrode tooth back respectively, and needs to have the function which collects efficiently the electrical and electric equipment further produced by the reaction. Moreover, since generation of heat which accompanies a cell reaction is large, in order to stabilize a service condition, it is necessary to make heat of reaction radiate heat through a gas separator. So, in the former, while accumulating two or more anodes and cathode complex (unit cell) on the gas separator and the PEM list in which the gas supply slot was formed to both sides, one by one and considering as a multiplex cel, a cooling jacket is prepared around this cell cel, or the structure which inserted the cooling board for every cel spacing of several sheets is adopted. Moreover, as shown in drawing 8 in recent years, the cooling structure of a jacket mold where cooling water can be poured at each tooth back of an anode and a cathode is proposed for every cel. However, in the former, it is difficult to cool every cel, and the periphery and the interior of each cel to homogeneity. Although cooling can be completely performed in the latter, there is a serious defect in removal of the superfluous generation moisture in the above-mentioned cathode. That is, in PEFC, ****** saturation is carried out with the steam, and if the inside of the pore of cathode 4C contacts the cooling jacket below the operation (dew-point) temperature of a cel to this, water will condense it to the near. Consequently, supply of reactant gas and removal of generation moisture are checked, and cell operating [of high current density] becomes impossible. Therefore, the proposal of cooling, the new cellular structure including the gas separator structure where all of dehumidification can be performed efficiently, and an operating method is indispensable.

[0006] Moreover, with the conventional cell structure, as shown in drawing 9 , the anode, the cathode, and the cooling jacket piled up in the thickness direction, have prevented miniaturization of a cel, and this poses the third problem. As PEFC for mount, the proposal of new cell structure which realizes this miniaturization is called for.

[0007] By the way, many above-mentioned problems were made into the problem of a fuel cell, and have been described. On the other hand, the electrolysis cell using ion exchange membrane can be made to completely perform a reverse reaction, i.e., electrolysis of water, with the same structure as a fuel cell so that it may be known well. Then, it becomes indication of the same trouble in an electrolysis cell by reading an anode with a cathode, reading a cathode with an anode, and replacing with by description of the above-mentioned fuel cell. A trouble with the same said of electrolysis reactions other than electrolysis of water exists.

[0008]

[Problem(s) to be Solved by the Invention] This invention solves the above-mentioned trouble, efficient cooling and the efficient dehumidification of it are attained, and equipment itself provides a compact fuel cell and an electrolysis cell list with the cooling / dehumidification approach.

[0009]

[Means for Solving the Problem] It is characterized by being the fuel cell with which the laminating of the separator plate which the anode and the cathode reaction gas supply slot arranged in parallel on the same flat surface by turns through a metallic thin plate or conductive resin sheet metal is carried out to each inter-electrode one, and an electrolysis cell, and the cross sections of an anode and a cathode reaction gas supply slot differing, a cathode reaction gas supply slot being larger [this invention] than an anode reaction gas supply slot, when it is a fuel cell, and an anode reaction gas supply slot being larger than a cathode reaction gas slot in the case of an electrolysis cell. Moreover, in the case of the internal manifold type with which the supply manifold of an anode and cathode reaction gas penetrates an electrode surface, with the fuel cell, a cathode reaction gas manifold is larger than the volume of an anode reaction gas manifold, and the anode reaction gas manifold is larger than the volume of a cathode reaction gas manifold by the electrolysis cell. Furthermore, the external manifold type in an electrode side face may be used, either an anode or a cathode reaction gas supply

manifold uses a cathode reaction gas manifold as an external manifold with a fuel cell in that case, and it uses an anode reaction gas manifold as an external manifold by the electrolysis cell. Furthermore by passing reactant gas to the fuel cell and electrolysis cell of the above-mentioned structure, this invention is the cooling / dehumidification approach of of the fuel cell and electrolysis cell which perform cooling and dehumidification of an electrode.

[0010]

[Function] The case of a fuel cell is explained first. In order to realize efficient cooling, in this invention, the part nearest to direct or it is cooled for the exoergic part through the good ingredient of pyroconductivity. By the way, as pointed out in the trouble of the conventional technique, when it cools by contact to the cooling surface below a dew-point, dew condensation of water will surely be produced focusing on a contact part with a cathode. So, in this invention, in order to avoid this problem, not using the cooling jacket, it decided to make reactant gas (oxygen or air) serve as a cooling medium (gas). Even if it cools, dew condensation stops arising, since the saturation ratio of the steam in cathode pore falls since a steam is promptly diffused in the coolant gas with which a steam is not contained and it is promptly removed out of a cell with this coolant gas by installation of a lot of coolant gas, and a dew-point falls more.

[0011] Moreover, since the overvoltage of a cathode is large compared with an anode, the thing which is the need is taken as the structure which can make the amount of supply of cathode reaction gas larger than the amount of supply of anode reaction gas by this invention in consideration of the point that the point that a cathode part becomes larger [generation of heat], and dehumidification are only cathode sides. The supply slot cross section of cathode reaction gas was specifically made larger than the supply slot cross section of anode reaction gas, and it considered as the structure which adopts an external manifold type as cathode reaction gas, or makes the volume of the manifold of cathode reaction gas larger than the volume of the manifold of anode reaction gas in an internal manifold type so that still a lot of coolant gas could be fed into a cathode reaction gas supply slot. When the cathode reaction gas as coolant gas can be passed in large quantities and air is used especially as coolant gas by considering as such structure, it combines with the efficient cooling / dehumidification effectiveness, and improvement in a cathode property can also be aimed at, and the various additional effectiveness that the amount of supply of anode reaction gas can be pressed down to necessary minimum is also produced.

[0012] Moreover, although this invention uses a metallic thin plate and conductive resin sheet metal for the separator plate, conductive resin sheet metal can be created beginning to injection mold or delete the composite of a metal or carbon, and resin. By being able to transmit the cooling effect of cathode coolant gas also to an anode promptly by this, and extracting, when it is a metallic thin plate, and really processing it, an anode and a cathode reaction gas supply slot can be fabricated, and it is effective in processing being simple and there being. In order that an anode and a cathode reaction gas supply slot may furthermore carry out mutual juxtaposition on the same flat surface, the thickness which an anode and a cathode reaction gas supply slot occupy is halved compared with the former, and since a cooling jacket is also unnecessary, a very [in equipment] compact thing is obtained. In addition, explanation of the above-mentioned fuel cell can be used as explanation of an electrolysis cell by reading an anode to a cathode, and reading a cathode to an anode, and replacing with.

[0013]

[Example] The embodiment of this invention is explained based on a drawing below.

[0014]

[Example 1] Drawing 1 thru/or drawing 6 explain the example of the fuel cell of the internal manifold type of this invention. Drawing 1 is a thing illustrating both sides of the separator plate used by this invention, and is thickness. The copper plate of 0.3mm** was created by spinning. Anode reaction gas supply slot 5A and cathode reaction gas supply slot 5C have the **** appearance shown in drawing 2 , and were made to form it in parallel with alternation in the same flat surface. The sectional view which cut this by A-B of drawing 1 is shown in drawing 3 a (A-B). As shown here, cathode reaction gas supply slot 5C is made larger than the cross section of anode reaction gas supply slot 5A. Moreover, the hole for manifolds shown in a separator plate in drawing 1 by 12A', 12A", 12C', and 12C" has opened.

[0015] On it, that gaseous diffusion layer 3A sticks [the separator plate] the gasket for anode sides shown in the anode side of this separator plate at drawing 4 for a gas diffusion electrode on lamination and a pan so that it may be suitable. Moreover, the gaseous diffusion layer 3C sticks [the separator plate] the gasket for cathode

sides shown in drawing 4 for a gas diffusion electrode on lamination and a pan in the cathode side of a separator plate so that it may be suitable. Thus, two or more things which the gas diffusion electrode stuck and were united with both sides of the made separator plate were prepared, and the fuel cell was created by putting in and carrying out the laminating of the ion exchange membrane between reaction layer 2A of a gas diffusion electrode, and reaction layer 2C. Some sectional views (what was cut in the field which goes to an anode and a cathode reaction gas supply slot direct) of this fuel cell are shown in drawing 5 . In addition, when putting a gas diffusion electrode on the both sides of a separator plate, the gas diffusion electrode was fixed on both sides of the electrode backup sheet shown by 11A and 11C of drawing 6 .

[0016] As shown in drawing 3 , the cross section of cathode reaction gas supply slot 5C is made larger than the cross section of anode reaction gas supply slot 5A. From a viewpoint of cooling and dehumidification, although the cross section of a cathode reaction gas supply slot is so desirable that it is large In consideration of the fall of the current collection ability by micrifying of current collection section 7C in a cathode pole, and inhibition increase of the gas supply ability by electric shielding of current collection section 7A in an anode pole, the cross section of a cathode reaction gas supply slot was made into about 3 times of the cross section of an anode reaction gas supply slot. In addition, in order to reduce the shielding effect by current collection section 7A, it considered as the structure where the touch area to the anode of 7A was decreased as shown in drawing 5 . on the other hand, in order to perform sufficient gas supply for this cathode reaction gas supply slot, it is shown in drawing 1 -- as -- the magnitude of manifold 12Cfor cathode reaction gas supply ', and manifold 12C" for cathode reaction gas discharge -- manifold 12for anode reaction gas supply A', and the object for anode reaction gas discharge -- it is made larger than MANIHODORU 12A", and that ratio is desirably made into 3 or more times.

[0017] By assembling a fuel cell as mentioned above, via a gas supply slot, the gas sent from each reaction gas manifold inlet port is led to a manifold outlet, and is discharged. Since the large passage of cathode reaction gas was taken at this time, it became possible to send in cathode reaction gas enough as coolant gas, and cooling and dehumidification of an electrode were attained perfect.

[0018] In addition, although the period of the separator plate which carries out a laminating is made in agreement in this example as shown in drawing 5 , it is good also as structure where the gas supply slot of the cel which it may shift a semicircle term and the current collection sections 7A and 7C may be made to counter in order to secure sufficient contact pressure of anode 4A, cathode 4C, and the current collection sections 7A and 7C, and adjoins intersects perpendicularly.

[0019]

[Example 2] In order to feed still a lot of gas for cooling / dehumidification than an example 1, the fuel cell which used the cathode manifold as the external manifold is shown in drawing 7 . Although the sectional view (what was cut in the field which goes in the direction of a gas supply slot direct) of a separator used here has a form like drawing 3 b (C-D) and anode reaction gas is led to an anode reaction gas supply slot from an internal manifold like an example 1 Cathode reaction gas was introduced into drawing 7 from the external manifold of the cell side face which is not illustrated, it became possible to pass still a lot of cathode reaction gas (cooling / dehumidification gas), and more sufficient cooling and dehumidification have been realized.

[0020]

[Effect of the Invention] The fuel cell of this invention has the manifold and cathode gas supply slot which have the structure where gas can be passed superfluously as above-mentioned. And since it has the separator structure which can also cool an anode through a thin right thermal-conductivity metal plate or conductive resin sheet metal, It not only can cool efficiently the cathode catalyst bed part which are the main exoergic sections, but it can cool an anode efficiently. And since it could remove out of the cell efficiently and the gas supply slot was further dedicated in the same field, without making a lot of moisture produced in a cathode dew, the thickness which occupies an anode and a cathode gas supply slot can be halved, and miniaturization and simplification can be attained, and low cost-ization can also be attained. Moreover, the same effectiveness as a fuel cell is acquired, without being able to cool an anode and a cathode efficiently in an electrolysis cell similarly, and producing dew condensation in an anode.

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DESCRIPTION OF DRAWINGS

[Brief Description of the Drawings]
[Drawing 1] It is the mimetic diagram of the separator plate in an example 1. (An above figure cathode side face, the following figure anode side face)
[Drawing 2] It is the perspective view of the separator plate in an example 1. (What was cut in part in order to see a internal structure)
[Drawing 3] It is the sectional view of a separator plate [in / a and / in b / an example 2]. [an example 1]
[Drawing 4] It is the explanatory view of the gasket in an example 1. (A top is a gasket for cathode sides and the bottom is a gasket for anode sides)
[Drawing 5] a part of fuel cell in an example 1 -- it is a sectional view.
[Drawing 6] It is the explanatory view of the electrode backup sheet in an example 1. (A top is an object for cathode sides and the bottom is an object for anode sides)
[Drawing 7] a part of fuel cell in an example 2 -- it is a perspective view. (The part is cut in order to see the interior.)
[Drawing 8] It is the principle Fig. of the solid polymer electrolyte mold fuel cell of a conventional type.
[Drawing 9] It is the explanatory view of conventional-type fuel cell water-cooled cooling structure.
[Description of Notations]
1 Ion Exchange Membrane (PEM)
2A Porosity catalyst bed (anode side)
2C Porosity catalyst bed (cathode side)
3A Conductive porous support (anode side)
3C Conductive porous support (cathode side)
4A Gas diffusion electrode (anode pole)
4C Gas diffusion electrode (cathode pole)
5A Reactant gas supply slot (for anode gas)
5C Reactant gas supply slot (for cathode gas)
6A Separator (anode side)
6C Separator (cathode side)
7A Current collection section (anode pole)
7C Current collection section (cathode pole)
8 Load
9 Cooling Jacket
10A Gasket (for anode sides)
10C Gasket (for cathode sides)
11A Electrode backup sheet (anode side)
11C Electrode backup sheet (cathode side)
12A' Manifold for anode reaction gas supply (inlet port)
12A" Manifold for anode reaction gas discharge (outlet)
12C' Manifold for cathode reaction gas supply (inlet port)
12C" Manifold for cathode reaction gas discharge (outlet)

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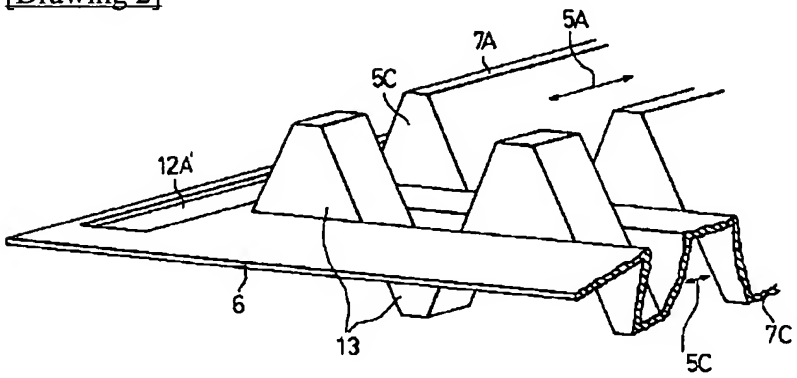
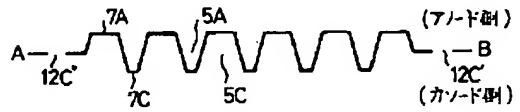
DRAWINGS

[Drawing 2]



[Drawing 3]

(a)



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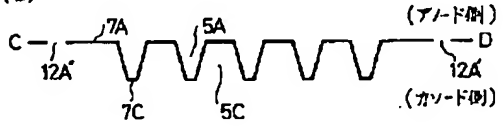
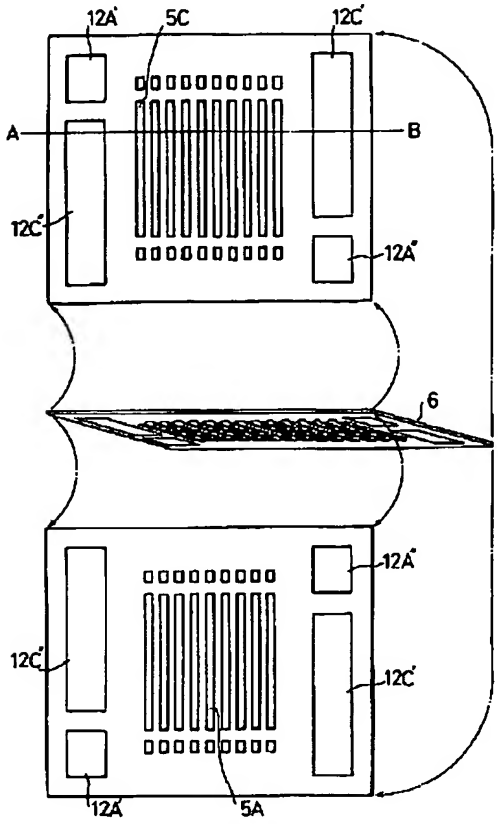


[Drawing 1]



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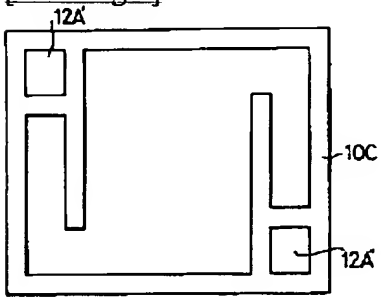

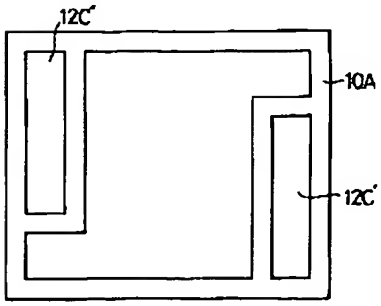

[Drawing 5]

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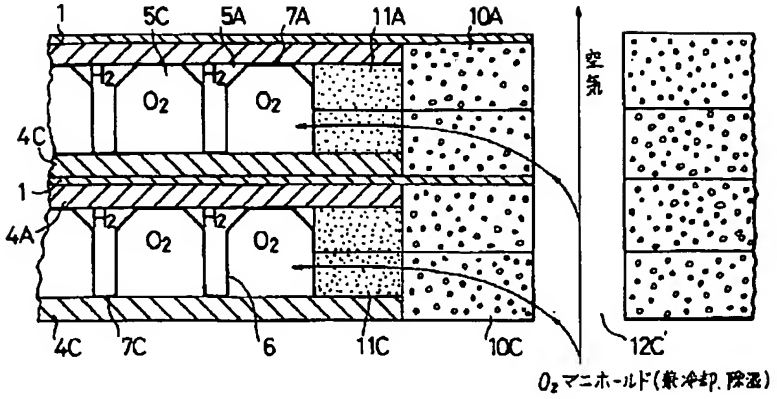

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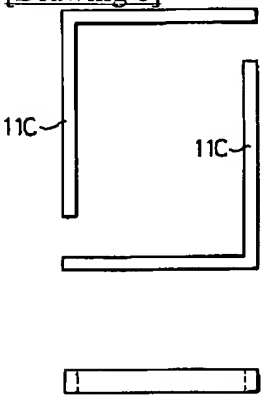

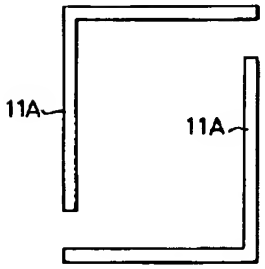

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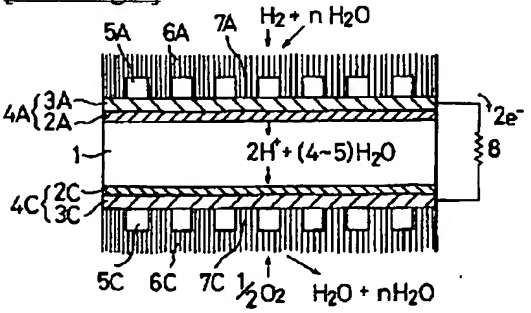

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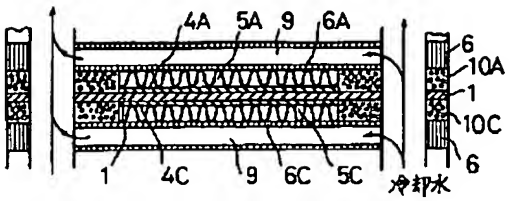

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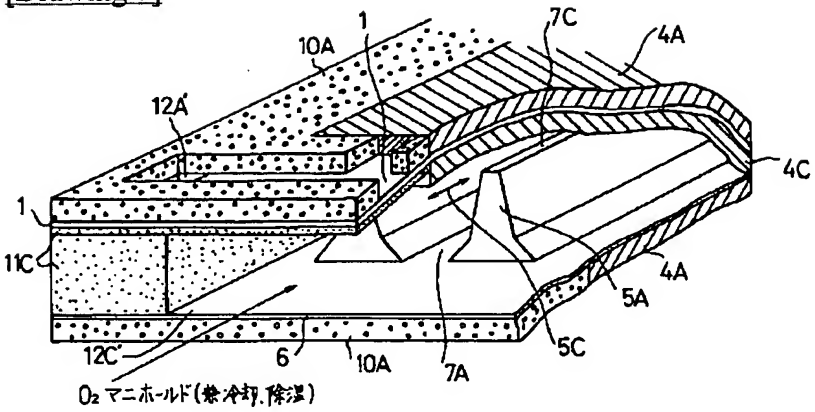

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